



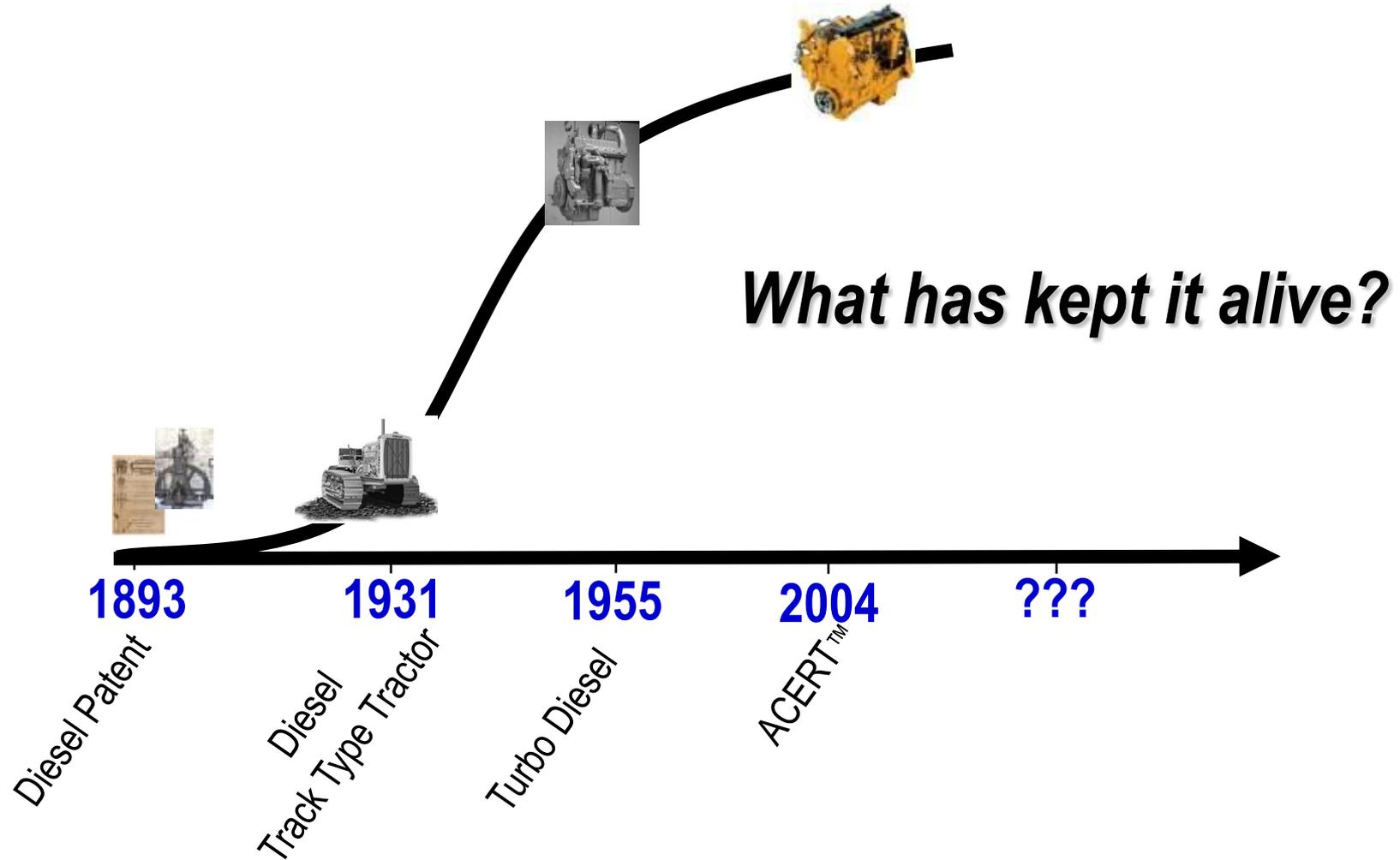
# Advanced Technologies for GHG Reductions



**Tana Utley**  
Chief Technology Officer  
Caterpillar Inc.

**MSTRS Meeting  
Washington DC  
May 13, 2009**

# Caterpillar's Legacy Platform



# Caterpillar's Legacy Platform

**Our Customers** 



- **Capital Goods**
- **Values-based Decisions**
- **Efficiency/Productivity**
- **Emissions**

**1893**

**1931**

**1955**

**2004**

**???**

*Diesel Patent*

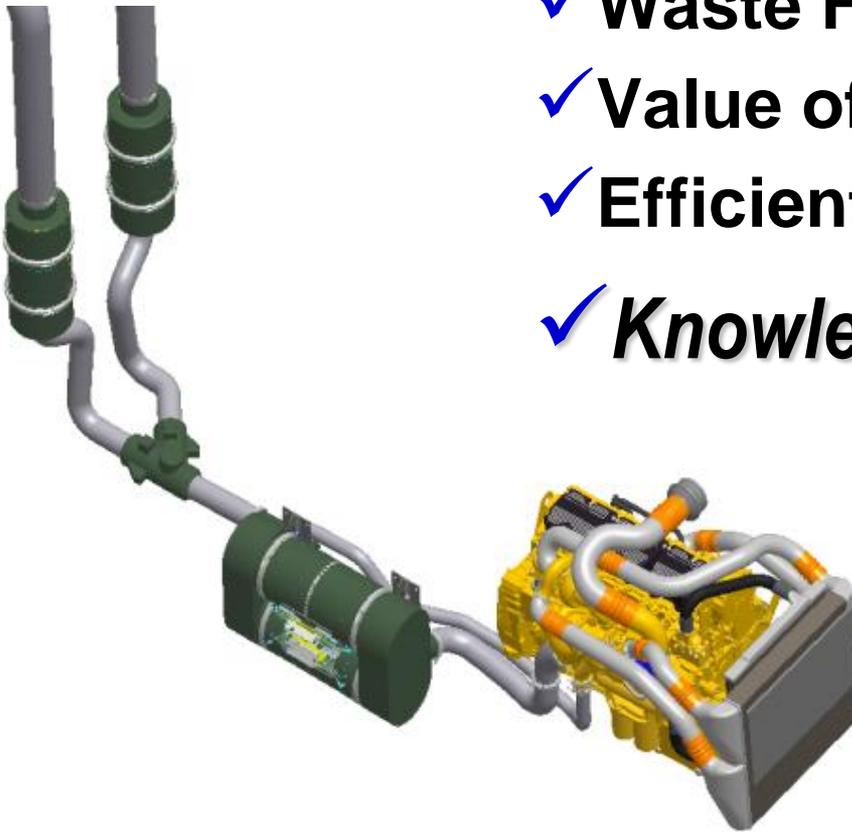
*Diesel Track Type Tractor*

*Turbo Diesel*

*ACERT™*

# Diesel Engine Progress

- ✓ Turbo Technology
- ✓ Waste Heat Recovery
- ✓ Value of Advanced Combustion
- ✓ Efficient Aftertreatment
- ✓ *Knowledge*



# Progress

*An investment in knowledge  
pays the best interest.*

*Ben Franklin*



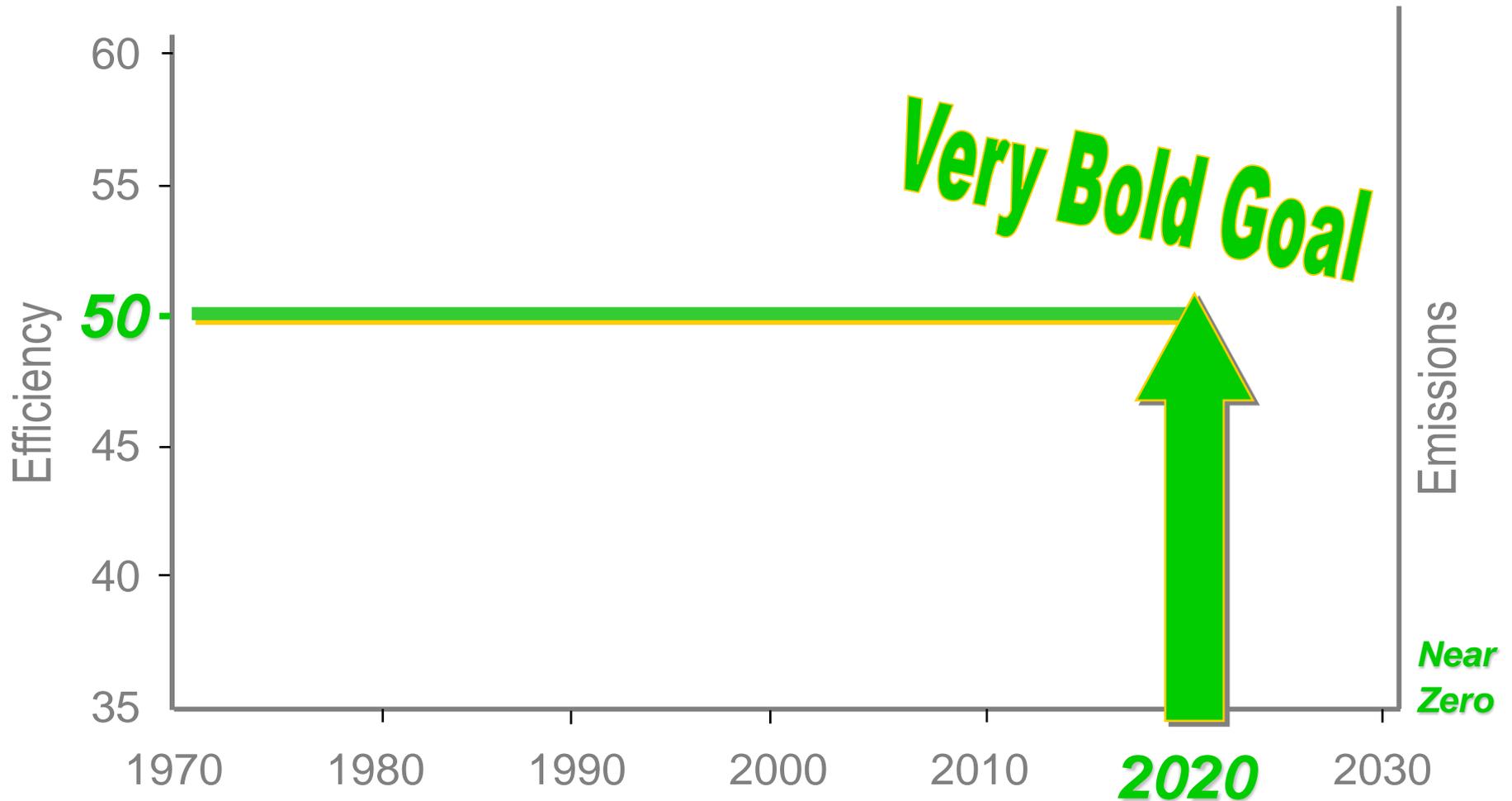
# Progress *Takes Money!*

Caterpillar's current R&D investment is substantially devoted to Tier 4 Interim and Tier 4 Final criteria pollutant reductions...

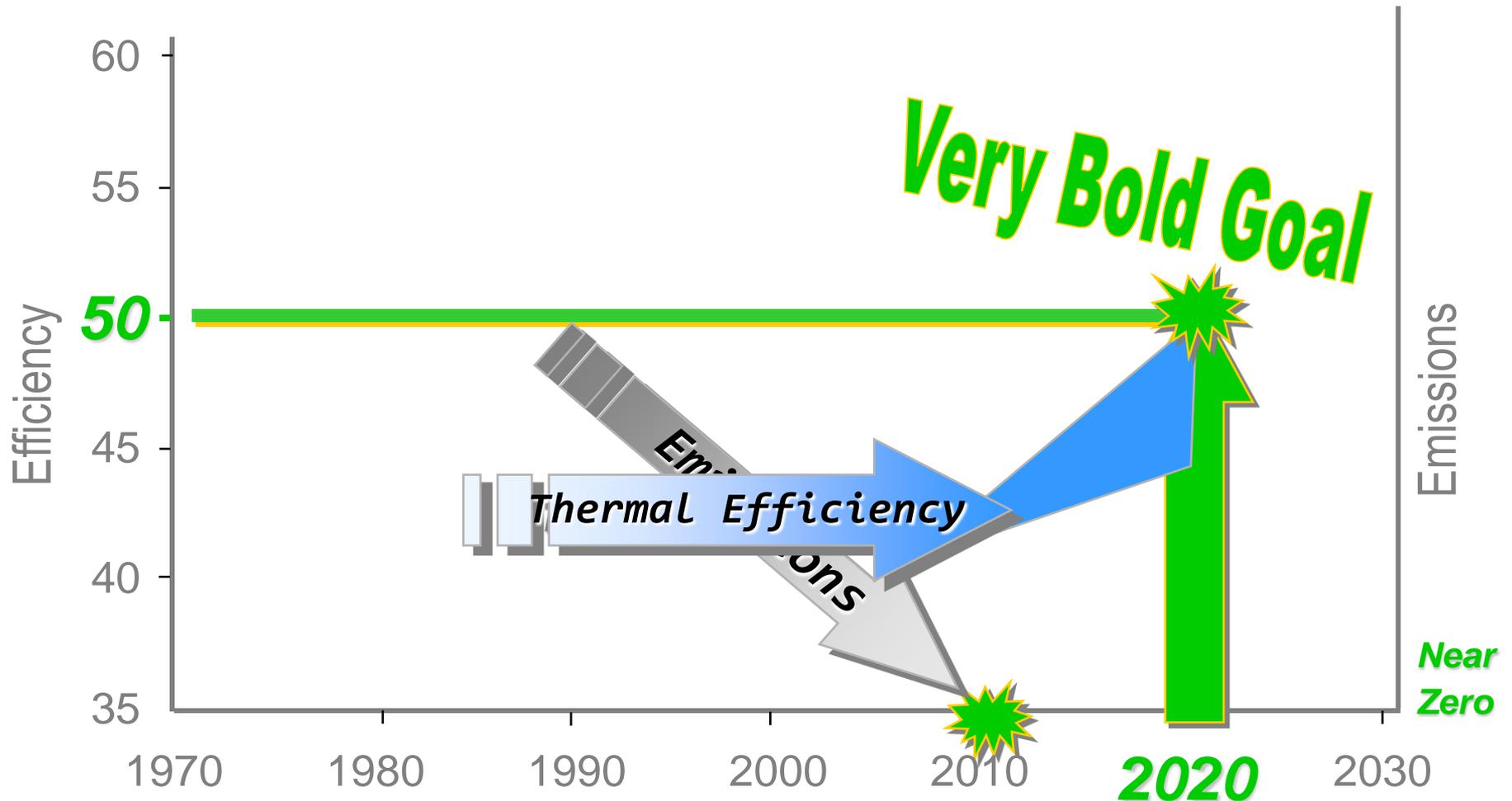
*...and is expected to remain this way through Tier 4 Final implementation.*



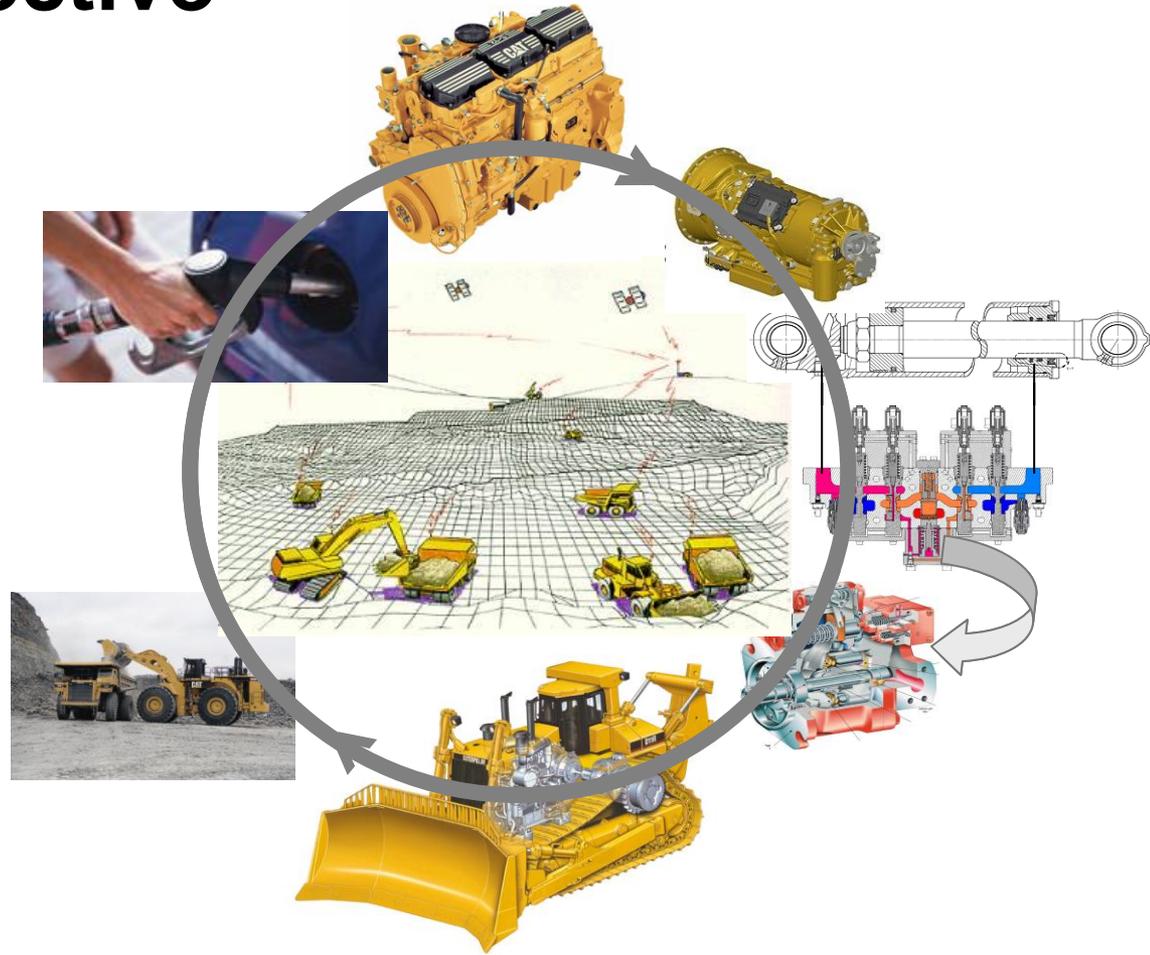
# Efficiency and Emissions Progress- Non-Road Diesel Engines



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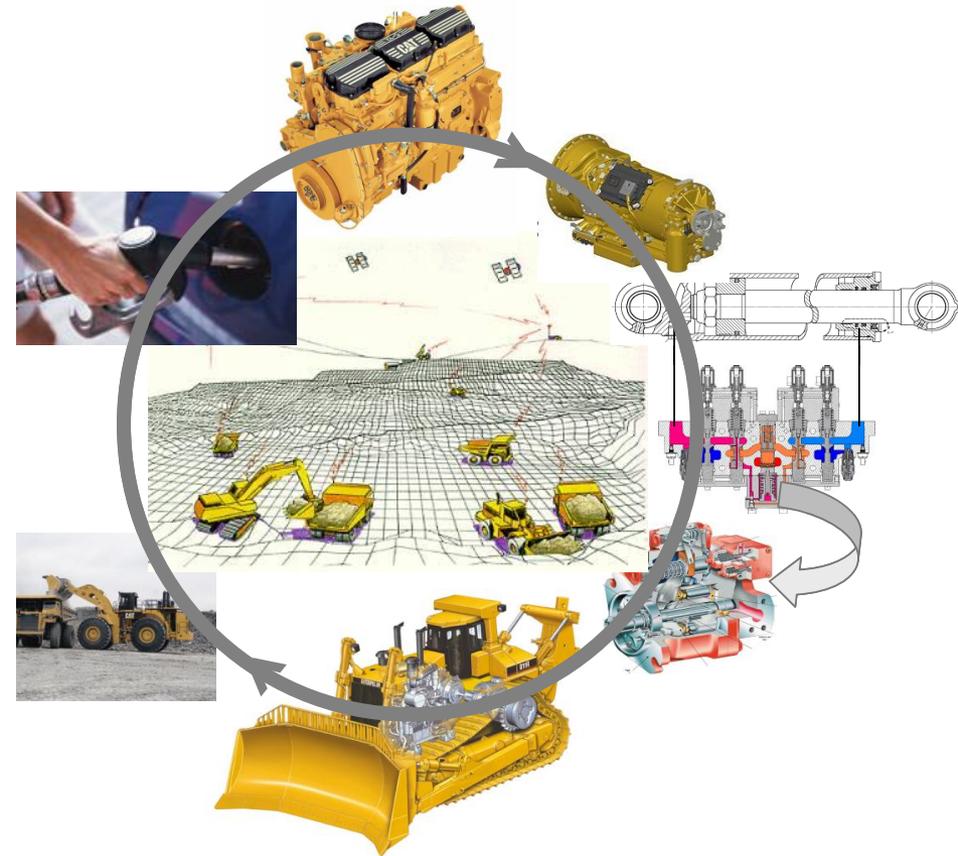


# Systems Perspective



# Systems Perspective ...Why?

- Enormous diversity and complexity in the world of non-road machines
- Machines need to perform many different functions
- Efficiency and productivity usually measured on a “work performed” basis at the job-site level



# Caterpillar Energy & Sustainability

*Four Areas of CO<sub>2</sub> Opportunity*



**Energy Sources**  
**Up to 100%**



**Zero Net Carbon Fuels**

**Job Site**  
**+10-30% Efficiency**



**Move the Dirt Once**

**Machine**  
**+10-20% Efficiency**



**System Optimization**

**Engine**  
**+5-10% Efficiency**



**New Combustion Technologies**

# D7E

First of its Kind with Electric Drive

*Machine Efficiency*

**50% less**  
operator noise

**50% better**  
steering performance

**10% lower**  
lifetime operating costs

**Easier to operate**  
No shifting  
Low-effort controls

**Less fluids used**

**35% more**  
visibility

**35%–70% lower**  
owning & operating costs with  
SystemOne™ undercarriage

**10% more**  
material moved per hour

**Up to 20% less**  
fuel consumed per hour

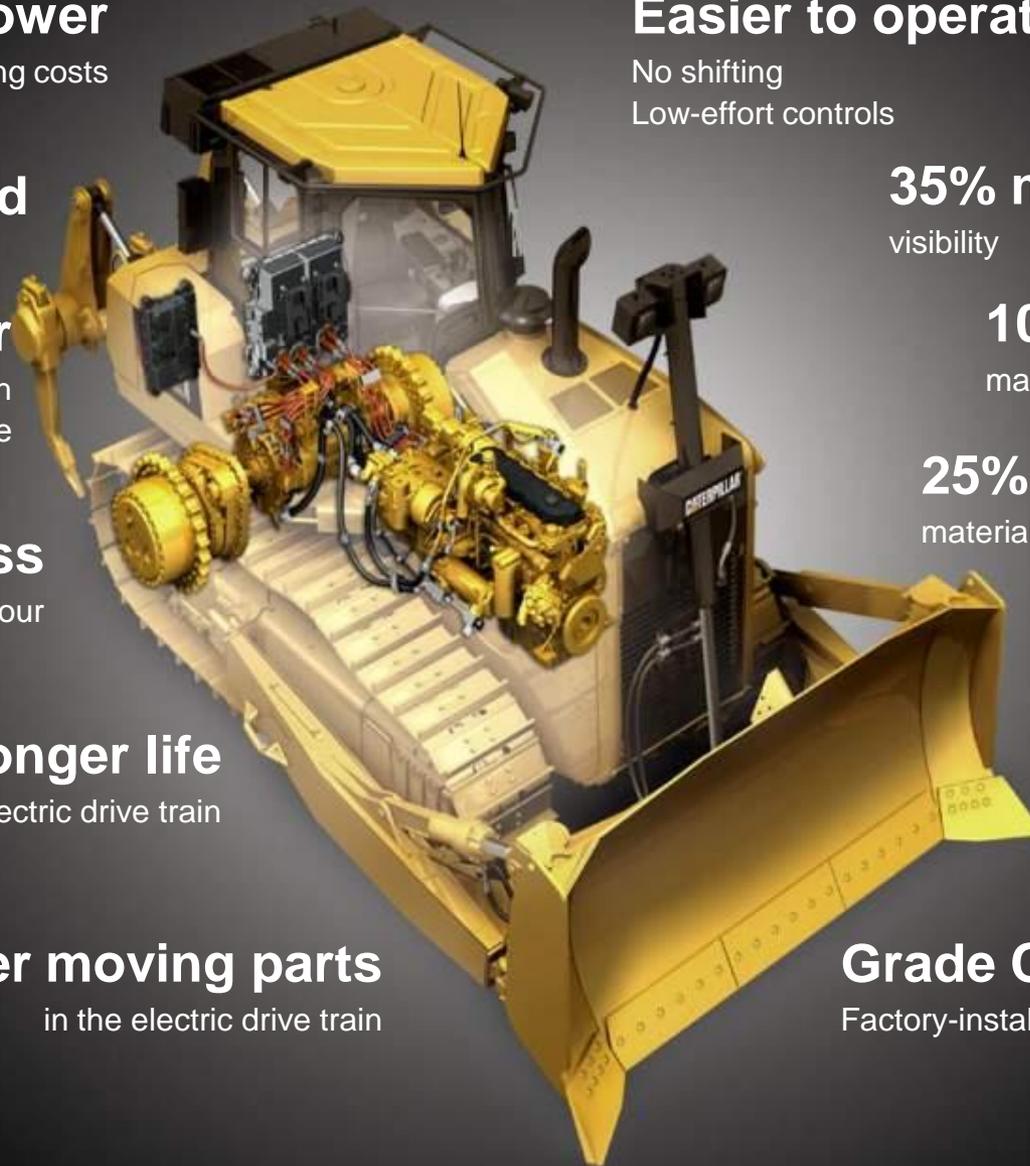
**25% more**  
material moved per gallon of fuel

**Up to 50% longer life**  
for the electric drive train

**Less down time**  
No engine belts

**60% fewer moving parts**  
in the electric drive train

**Grade Control Ready**  
Factory-installed AccuGrade™



# Work-Site Efficiency

## D10 Utilizing Computer Aided Earthmoving System (CAES)

- ✓ Global Navigation Satellite System Technology
- ✓ Integrate machine with office
- ✓ Latest machine guidance system
- ✓ Real time productivity information
- ✓ CAES has shown on average 20-25% productivity improvement



# Work-Site Efficiency

## Caterpillar's AccuGrade™ GPS System for Road Construction

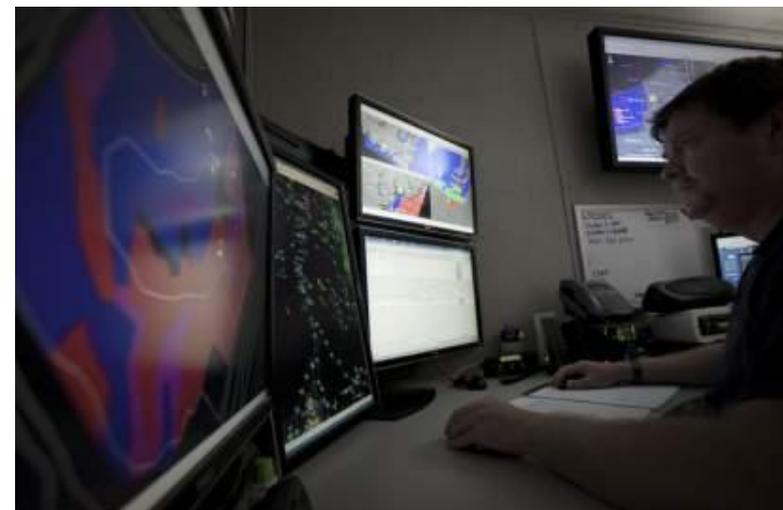
- ✓ GPS System components installed both on machine and on job-site
- ✓ Integration of machine controls with GPS system
- ✓ Highest degree of precision for grading and excavating
- ✓ Greater accuracy minimizes number of passes
- ✓ Productivity study showed that AccuGrade™ demonstrated a remarkable *43% fuel savings*



# Work-Site Efficiency

## Caterpillar's MineStar™ FleetCommander

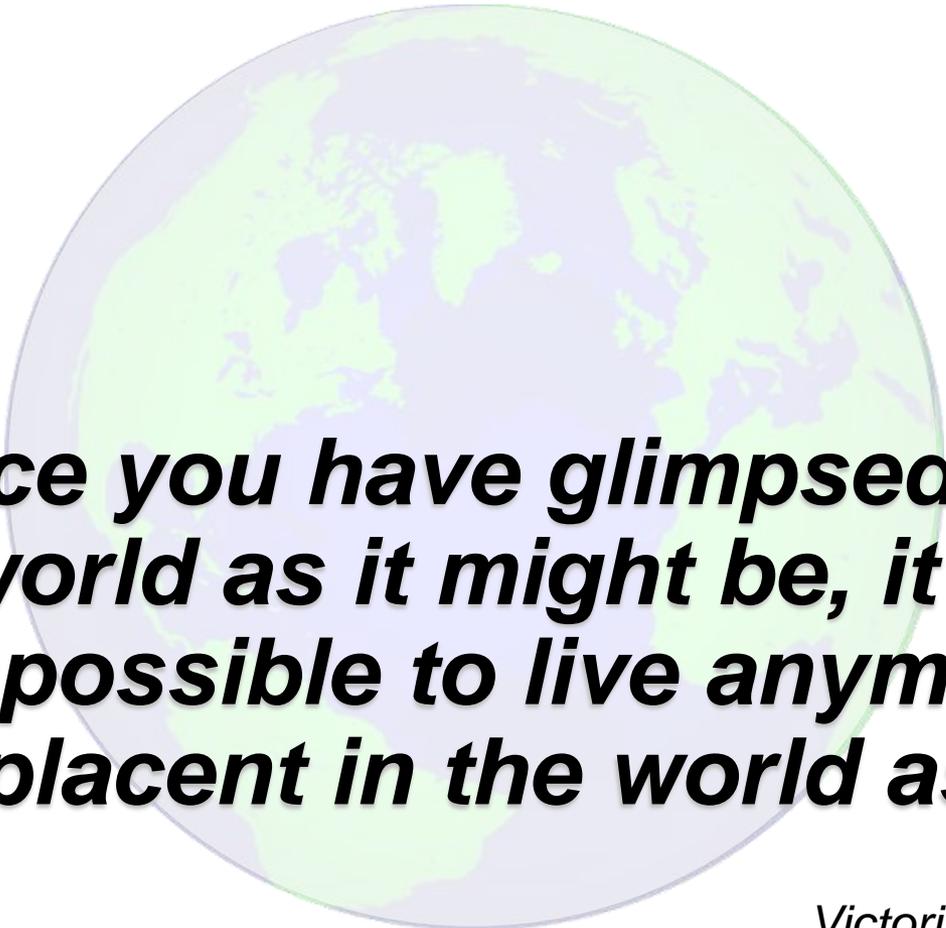
- ✓ Installed at both machine and mine-site office levels
- ✓ Monitors and controls the routing of complete network of mining fleet
- ✓ MineStar™ can increase mine productivity by as much as 15%
- ✓ MineStar™ means less idling time
- ✓ Greater productivity and less idling time means significantly less fuel consumption (GHG's)



# Focus on Fuel

- ✓ Zero Net Carbon Diesel Fuel
- ✓ Price for carbon in fuel will drive the right behavior at both the 'Fuel' level and the Machine and Total Integrated Systems levels
- ✓ Technology Neutral





***Once you have glimpsed the  
world as it might be, it is  
impossible to live anymore  
complacent in the world as it is.***

*Victoria Safford*

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